Chlorophyll retrieval studies using Differential Optical Absorption Spectroscopy on SCIAMACHY data and comparisons to MERIS

A. Bracher, M. Vountas, T. Dinter, B. Sierk, J. P. Burrows

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FAX: 0421-218-4555, email: bracher@uni-bremen.de

Global primary production & phytoplankton absorption & chl *a*

Global models on marine primary production (PPR):

- function of fixed org. carbon to biomass (chl *a*) & light
- rarely consider spectral dependency of photosynthesis
- use ocean color satellite sensors (MERIS, MODIS, SeaWIFS,…) data on chl *a*, surface water reflectance and light penetration depth

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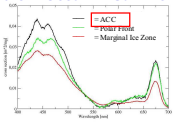

Spectrum from Antarctic Circumpolar Current (ACC) used in SCIAMACHY DOAS retrieval explained below; Fig. from Bracher & Tilzer 2001)

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Important to derive information on attenuation of underwater components, above all the specific phytoplankton absorption from satellite data and Vibrational Raman Scattering (see Vountas et al. 2003) to improve chl a retrievals from satellite data and by that also global primary production estimates:

Synergistic use of the two ENVISAT instruments with information at 400 to 700 nm :

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- Determine phytoplankton slant columns and VRS fit factors and compare them to MERIS algal_1 chl *a* concentrations

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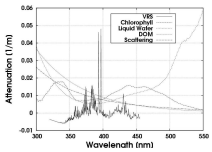

Principal Component Analysis

Problems of direct DOAS fitting of phytoplankton

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Solution: Principle Component Analysis PCA
(*see* Dinter 2005, Vountas et al. 2005)

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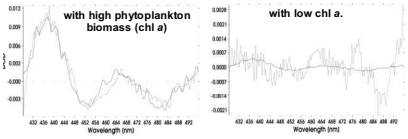

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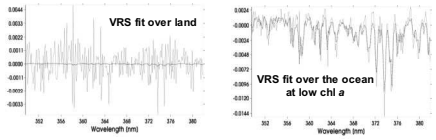

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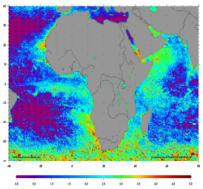

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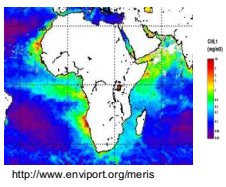

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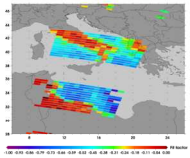

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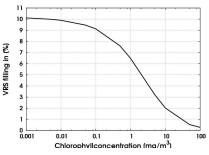

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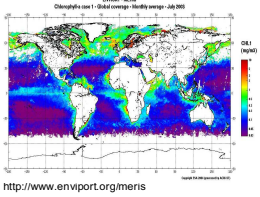

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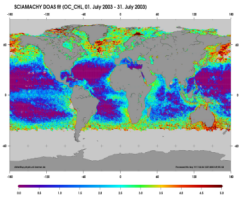

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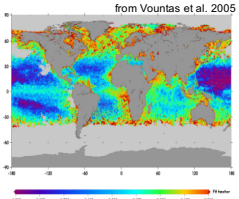

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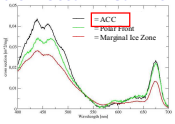

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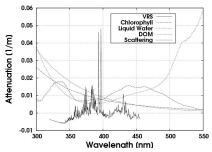

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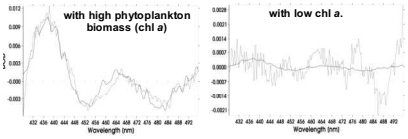

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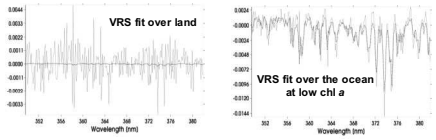

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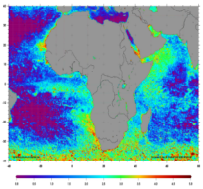

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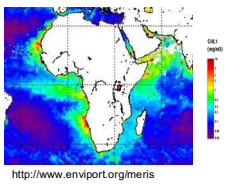

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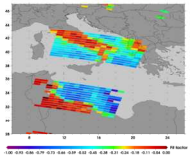

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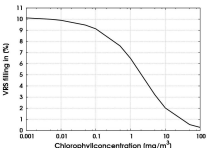

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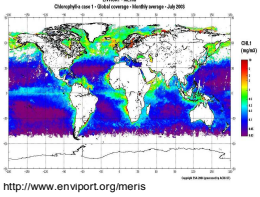

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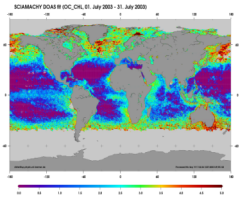

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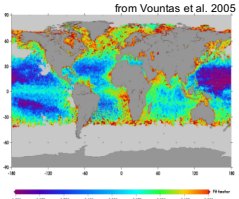

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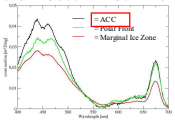

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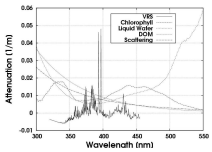

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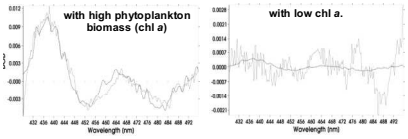

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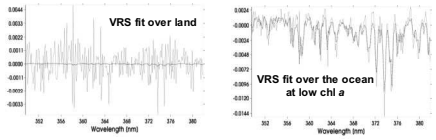

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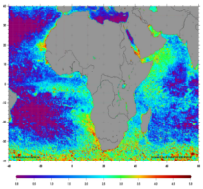

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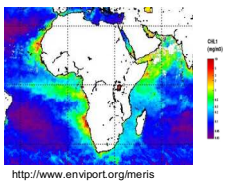

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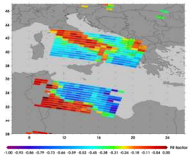

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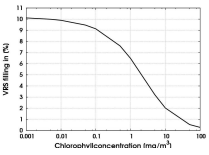

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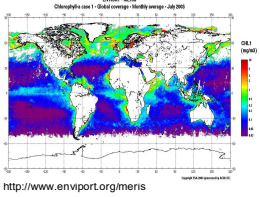

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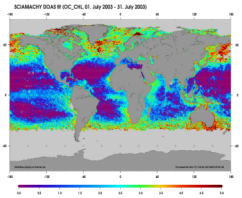

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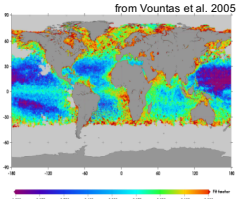

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Chlorophyll retrieval studies using Differential Optical Absorption Spectroscopy on SCIAMACHY data and comparisons to MERIS

A. Bracher, M. Vountas, T. Dinter, B. Sierk, J. P. Burrows

University of Bremen, FB 1, Institute of Environmental Physics, P O Box 330440, D-28334 Bremen, Germany;
FAX: 0421-218-4555, email: bracher@uni-bremen.de

Global primary production & phytoplankton absorption & chl *a*

Global models on marine primary production (PPR):

- function of fixed org. carbon to biomass (chl *a*) & light
- rarely consider spectral dependency of photosynthesis
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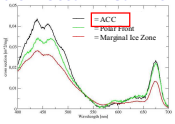

Spectrum from Antarctic Circumpolar Current (ACC) used in SCIAMACHY DOAS retrieval explained below; Fig. from Bracher & Tilzer 2001)

Specific absorption varies strongly for different provinces!

Important to derive information on attenuation of underwater components, above all the specific phytoplankton absorption from satellite data and Vibrational Raman Scattering (see Vountas et al. 2003) to improve chl a retrievals from satellite data and by that also global primary production estimates:

Synergistic use of the two ENVISAT instruments with information at 400 to 700 nm :

MERIS good spatial resolution ~1 km²

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DOAS-method used for ocean optics

Retrieval of trace gases (now applied to phytoplankton and VRS) by differential optical absorption spectroscopy (DOAS, Platt 1994) uses differential absorption signal of the molecular absorber in the earthshine spectrum. Forming the ratio of earthshine spectrum to extraterrestrial solar irradiance removes instrumental and Fraunhofer features.

Input:
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Pseudo-absorber: spectrum of atmospheric Ring and VRS in liquid water* (modelled)
*contribute to the inherent optical properties of the water body, as seen in figure to the right
Procedure:
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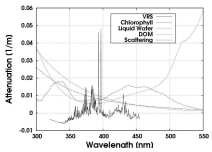

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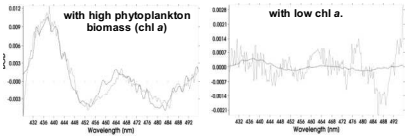

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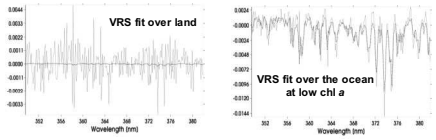

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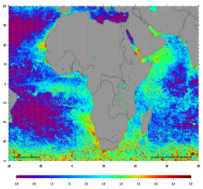

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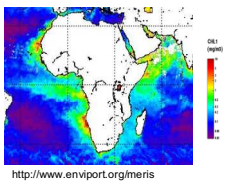

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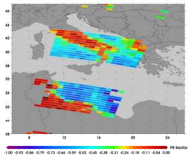

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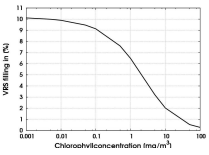

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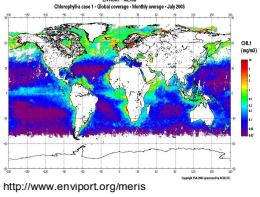

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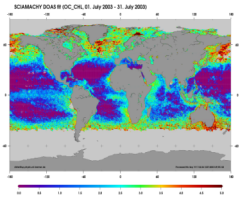

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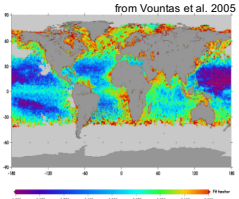

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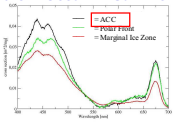

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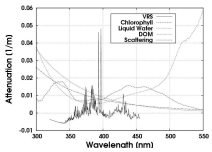

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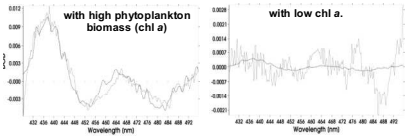

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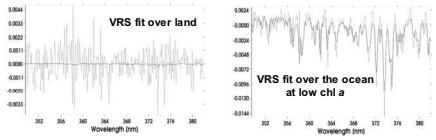

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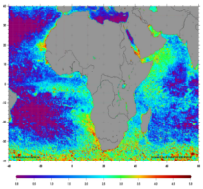

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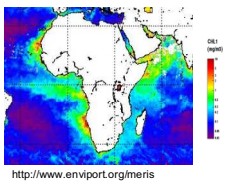

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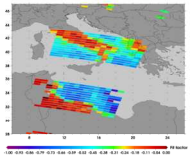

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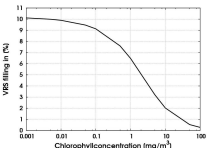

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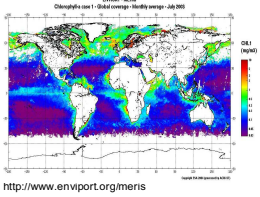

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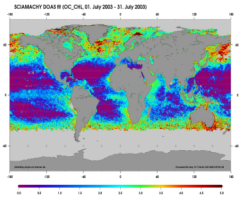

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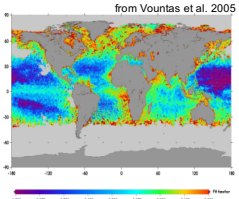

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Chlorophyll retrieval studies using Differential Optical Absorption Spectroscopy on SCIAMACHY data and comparisons to MERIS

A. Bracher, M. Vountas, T. Dinter, B. Sierk, J. P. Burrows

University of Bremen, FB 1, Institute of Environmental Physics, P O Box 330440, D-28334 Bremen, Germany;
FAX: 0421-218-4555, email: bracher@uni-bremen.de

Global primary production & phytoplankton absorption & chl *a*

Global models on marine primary production (PPR):

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- rarely consider spectral dependency of photosynthesis
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Limitations to PPR models and chl a from ocean colo:

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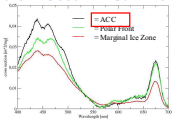

Spectrum from Antarctic Circumpolar Current (ACC) used in SCIAMACHY DOAS retrieval explained below; Fig. from Bracher & Tilzer 2001)

Specific absorption varies strongly for different provinces!

Important to derive information on attenuation of underwater components, above all the specific phytoplankton absorption from satellite data and Vibrational Raman Scattering (see Vountas et al. 2003) to improve chl a retrievals from satellite data and by that also global primary production estimates:

Synergistic use of the two ENVISAT instruments with information at 400 to 700 nm :

MERIS good spatial resolution ~1 km²

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- Determine phytoplankton slant columns and VRS fit factors and compare them to MERIS algal_1 chl *a* concentrations

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Input:
Absorption cross section for molecular species: photosynthetic pigments*, yellow substance* (dissolved organic matter, DOM), O_3, NO_2, H_2O-vapor+- liquid* (measured)
Pseudo-absorber: spectrum of atmospheric Ring and VRS in liquid water* (modelled)
*contribute to the inherent optical properties of the water body, as seen in figure to the right
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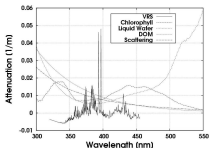

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Problems of direct DOAS fitting of phytoplankton

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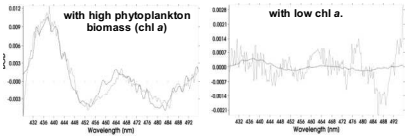

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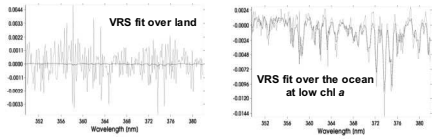

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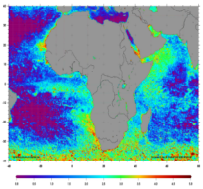

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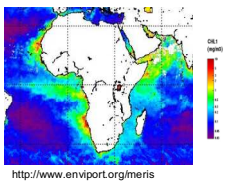

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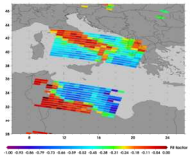

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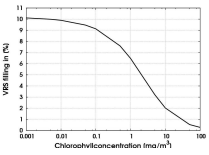

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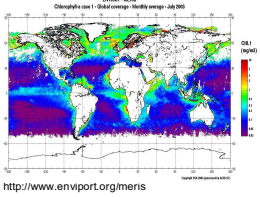

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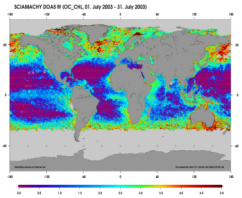

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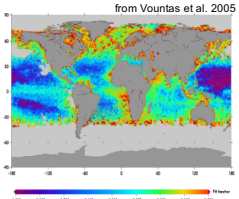

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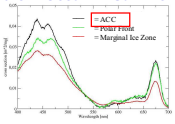

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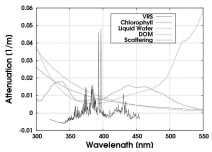

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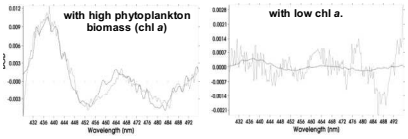

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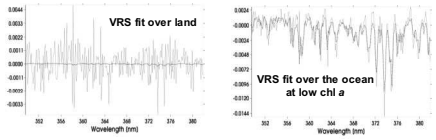

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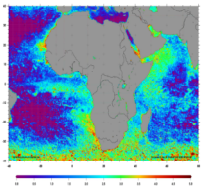

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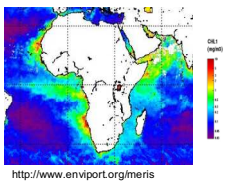

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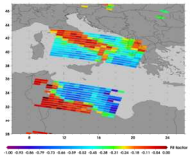

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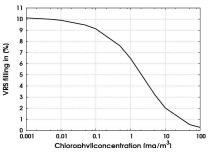

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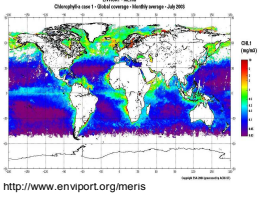

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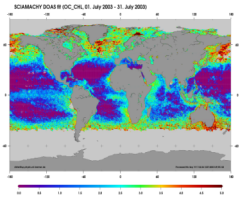

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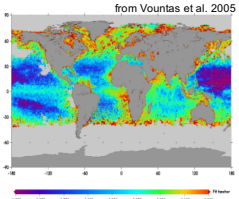

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